

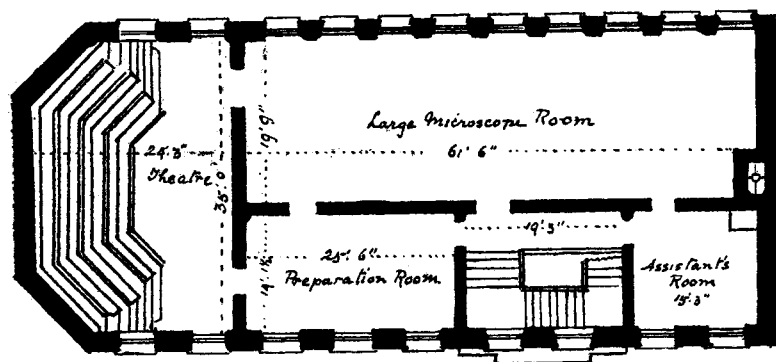
In conclusion, Dr. Mascart points out that perhaps the most valuable result of the recent attack is the experience gained, and he emphasises the details in the programme which need greater attention, such as the closer observance of the precise prearranged hour, the correct orientation of the final drawing, the care which should be exercised in confirming the presence of a faint marking before showing it on the drawing, and so on. Finally, he gives, with full detail, descriptions of various objectives and eye-pieces, showing in each case, by means of diagrams, their action on rays of light.

Taken as a whole, this preliminary campaign appears to have provided very valuable results, and it is to be hoped that future similar organisations will be guided by the experience now gained.

W. E. R.

THE NEW SCHOOL OF BOTANY, TRINITY COLLEGE, DUBLIN.

THE science schools committee of Trinity College, Dublin, is to be congratulated on the completion of the second item in its scheme for the scientific development of Trinity College. This project, which was in the first instance originated by Prof. John Joly, F.R.S., and has since owed much to his activity and devotion, was inaugurated in 1901 by a handsome subscription from the chancellor, the Earl of Rosse. At an early stage in the movement success was assured by a munificent gift from



First Floor Plan.

Viscount Iveagh. According to the terms of this gift, Lord Iveagh undertook to build those departments for which the friends of Trinity College subscribed a capital sum requisite to yield the annual upkeep. Last year the School of Physics was completed, and at the beginning of the present session the School of Botany, the second department which has been benefited by this movement, was opened for work.

The School of Botany is a two-storied building of cut granite, situated in the east end of the college park, and lies east and west. This orientation gives a large number of windows facing north, with the best light for microscopic work. The western end, being octagonal, is occupied by a lecture theatre in the upper storey, on the ground floor by a very fine laboratory for general physiology. The northern side of the upper storey is occupied by a large microscope room, which can accommodate about sixty students working simultaneously. Through a large double door in the west end of this room access is obtained to the theatre. The auditorium in the latter is octagonal, so that every seat is close to the lecture table.

On the ground floor on the north side is a room for microscopic research, a library, professor's laboratory, and the laboratory for general physiology, which also forms the west end of the building. A solidly built greenhouse running out on the north side of the building is immediately connected with the physiological laboratory: on the south side of the latter opens a chemical laboratory. In addition to the usual fittings in the physiological laboratory, there

is a large dark chamber, constructed like a fume cupboard, in which plants may be grown in complete darkness, or illuminated by light transmitted through special filters. The greenhouse has a separate heating system from the rest of the building, and a centrally placed case in it may be heated by a special radiator to a higher temperature than the rest of the greenhouse. Much thought has been given to the working out of the plan and fittings of this new school, and as it stands the School of Botany in Trinity College must rank with the best in the British Isles. The architect was Mr. Wm. C. Marshall, of London, who also designed the Botanical Laboratory in Cambridge.

ON THE COLOURING MATTERS OF FLOWERS.

THIRTY or forty years ago I devoted much attention to the colouring matters in plants, studying them with my newly invented spectrum microscope. I published a few papers on particular branches of the subject, but there are other very wide questions the importance of which I did not perceive until altered circumstances led me to devote my attention to work out at sea. Amongst other things studied was the variation in the colour of flowers, which is manifestly a very extensive subject, and for which I had only limited opportunity to obtain the requisite material, having to rely to a great extent on wild plants and flowers in my garden. Though the results are incomplete, they are probably characteristic; and it may be well to publish them, since it is now impossible for me to complete them, and what I did will at all events serve to show what might be done. The whole subject is very complex in more ways than one.

The colouring matters of plants may be divided into two divisions, viz. those soluble in water but insoluble in carbon bisulphide or benzol, and those soluble in the latter reagents but not in water. Both are soluble in hydrous alcohol of the usual strength. Nearly all the blues and purples belong to the former, and most of the yellow and orange to the latter.

I found the best way of dealing with the flowers was to boil the petals or other portions in the usual hydrous alcohol, which dissolves both groups of pigments, and, after evaporating to dryness, to re-dissolve the constituents soluble in water, filter, and finally evaporate to dryness in a small saucer, in which, if kept fairly dry, the pigment will remain unchanged for a considerable time. Some pigments may be kept unchanged for a long time in a concentrated solution of lump sugar.

When re-dissolved in water many of the colouring matters soon become pale or nearly colourless, but recover their colour when evaporated to dryness. I never saw proof of this in living flowers, but it may occur when they die and fade. If there be any colour insoluble in water, it may be dissolved in carbon bisulphide, but this is seldom the case in blue, red, or purple flowers.

In those cases where the predominant colour is insoluble in water, it may be separated by agitating the alcoholic solution with carbon bisulphide, adding a little water. The bisulphide carries down the pigment in solution, which may then be evaporated to dryness in a small saucer and kept. When dissolved in alcohol or carbon bisulphide the colour fades more or less quickly, especially in the light, but if sealed up almost absolutely free from air, it will remain unchanged for many years, at all events in the dark.

Having, then, obtained the pigment in a fit state, the next thing is to examine it when in appropriate solution, either in its natural state or after the addition of a suitable reagent. To enter into full detail would make this paper far too long, but it seems desirable to give some particulars in order to show how the various pigments can be distinguished. Speaking generally, this is by their

optical properties, occasionally by the fluorescence, but usually by the absorption, as studied by a spectrum microscope, and whenever possible by the position of absorption bands under identical known conditions. This latter is very important, since their position may vary considerably with the character of the solution. I never attempted to obtain the pigments pure, in a state fit for chemical analysis, so as to determine their chemical composition.

The number of distinctly different colouring matters in flowers must be very great, and to study them completely would occupy a long time. The distribution of the different kinds is sometimes very definite, but often the reverse. In the genus *Hypericum* are sometimes small dark spots in the petals, and sometimes small dark rounded bodies are attached to the sepals. These are coloured by a pigment which gives a spectrum with narrow, well-marked absorption bands, which could not be mistaken for any other. This occurs in all the species I examined, but in no other flowers. On the contrary, there is a blue pigment, giving a sufficiently well-marked spectrum with several absorption bands, met with in many flowers separated about as much as possible botanically.

Much may be learned by the use of reagents. Vegetable pigments may be divided into three groups by the action of sodium sulphide, which I called Groups A, B, and C. Group A is at once made nearly or quite colourless by the addition of a small quantity of this salt. Group B is not at all altered when alkaline or neutral, but is at once made nearly colourless when acid. Group C is not changed even when acid. When made colourless the pigments are not permanently decomposed, but recover their colour when evaporated to dryness. I do not fully understand the cause of these effects.

Then, again, much may be learned from the action of citric acid and a weak alkali. The colour and spectra of many reds, purples, and blues are very different in acid, neutral, or alkaline solution. Some yellow pigments are made thirty times more intense by an alkali, whilst others are unchanged. As a rule, none of the above changes is due to a permanent alteration, but in some cases it is useful to employ stronger reagents, which decompose the natural pigments, such as nitrite of soda with the addition of a little citric acid. As an example I may cite the pigment of the common yellow garden crocus. This gives a strongly fluorescent yellow substance, unlike that produced in the case of any other flower I have examined. The only objection to such powerful reagents is that they may produce highly coloured substances from colourless bodies in the plant, and not merely alter the coloured constituent. As an interesting example I may name a deep red substance produced in the case of the different species of geranium examined, but not in the case of any other plant.

My remarks so far apply only to colouring matters soluble in water. Orange, orange-yellow, and lemon-yellow flowers are in most cases coloured by one or other of the four yellow pigments met with in green leaves, or by various mixtures of them, which are distinguished by the absence or presence of two absorption bands. These vary considerably in position according to the nature of the solvent, lying much nearer the red end of the spectrum when the pigment is dissolved in carbon bisulphide than when in benzol or alcohol. These absorption bands can also be seen in the spectra of the flowers themselves, and for some time I was unable to understand why in the case of *Chelidonium majus* they lay materially nearer the red end than in nearly all other yellow flowers which gave the same spectrum when the pigment was in solution, until I came to the conclusion that in *Chelidonium* it occurs in a free state, and not dissolved in oil or wax. There are other cases in plants where the spectra show that the pigments exist in a solid state, which would explain slight differences in tint.

We may now consider facts very common in cultivated plants, viz. a great variety of colours. In many cases this is easily explained, because we can see that two pigments exist, either alone or mixed in various proportions, one frequently being a yellow insoluble in water, and the other a blue or red soluble in it. As an example, I refer to the common wallflower of our gardens (*Calendula vulgaris*), which is sometimes a clear yellow, sometimes

a sort of crimson, but more commonly a crimson brown. The yellow is a xanthophyl soluble in carbon bisulphide; the crimson is a pigment soluble in water; the common colour is a mixture of these two, and gives the same spectrum as a yellow and a purple petal combined. We have a similar case in chrysanthemums and various other flowers. The common garden marigold is sometimes a pure yellow and sometimes a true orange or an intermediate tint, which is due to two different pigments alone or variously mixed. One or other of these may occur separate in different parts of the same flower in some plants.

In some flowers we find a considerable variety of tints, probably due to another cause. The common bedding geraniums of our gardens are a good example of this. At one time I thought that such varying tints might be due to varying acidity, but did not obtain satisfactory proofs, though it may be true in some cases. I, however, studied several closely allied pigments from other plants, and found that they seemed to agree in nearly every particular, except that the absorption bands in the spectra were not exactly in the same place. An excellent example of this kind is the red pigment of blood, giving two very well-defined absorption bands, which differ in position if the oxygen is replaced by carbonic oxide or nitrous oxide. Also the red pigment found in many birds' eggs, which I named oorhodeine, gives precisely the same remarkable and well-marked spectrum as the product of the action of strong sulphuric acid on the red pigment of blood, except that the position of the absorption bands differs distinctly. My suggested explanation of the difference in the colour and spectra of a number of the pigments in flowers is that some fundamental constituent is the same, but modified by some varying substance in combination.

A few flowers contain pigments which give spectra with unusually well-marked absorption bands. As remarkable examples I may mention the crimson *Cineraria* and the deep blue *Lobelia* of our gardens. The spectra are of almost exactly the same character, having two dark absorption bands, only they occur at a different part of the spectrum. I am unable to say whether this shows any relationship between the pigments, but the difference in the position of the bands is perhaps too great.

It will thus be seen that a very great number of distinct pigments are found in flowers, sometimes having a very restricted distribution, and sometimes the reverse. Then, again, the plant may be able to form two or more quite distinct colouring matters, either alone or mixed in varying proportions. In some cases the pigments seem to be easily subject to change, as though some constituent could be substituted for another. In one way or another there is thus great scope for variation, perhaps not brought into play, or only to a limited extent, in wild plants, but sometimes to a remarkable extent by cultivation.

H. C. SORBY.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Vice-Chancellor has received a letter from Baron von Hugel, curator of the Museum of General and Local Archaeology and of Ethnology, recording a gift from the Rev. John Roscoe, of the Church Missionary Society, of exceptional value and interest. It consists of a second instalment of selected native manufactures from Uganda. The chief value of the gift lies in a unique set of relics of deceased Baganda kings, which, enclosed in ornate cases, were preserved by the people under the name of Lubare (*i.e.* the Deity) in special shrines placed under the guardianship of hereditary custodians. Of these king-gods, the most sacred objects of Baganda cult, three generations are represented in the present collection.

With the first Roscoe collection, which was supplemented by a valuable gift of objects from the Katikiro of Uganda, the University acquired Kibuka, the war god of the Baganda, who with all his appurtenances was safely unearthed from his ruined shrine in the Mawokota district. In this deity, as in the Lubare, personal relics form the essentials, and in Kibuka are enshrined the jaw-bone, &c.,